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Ash and fire, char, and biochar in the environment

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Abstract

© 2018 John Wiley & Sons, Ltd. Fire is an extreme event leading to rapid and dramatic losses of carbon (C), nutrients, and ballast elements from ecosystems and leaving ash and char on the soil surface. This affects soil processes, properties, and functions. Similar effects can be induced by applying biochar—the product of artificial pyrolysis of plant materials and organic wastes. The nutrients in ashes remaining after a fire or in biochar after pyrolysis will be leached within a few years, and only the highly condensed material will remain in the soil over centuries and millennia. This Special Issue (SI) is devoted to ash, fire, char, and biochar in the environment, with a special focus on soil processes and properties. We begin by comprehensively summarizing the positive and negative effects of fire, ash, char, and biochar on the physical, chemical, and biological properties of soils. We then review the 15 papers contributing to this SI. The first group of studies focuses on reconstructing fires during the Holocene and then linking them to human activities and land use. These studies clearly concluded that the fire frequency strongly increased with human invasion and occupation, and that charcoal properties are useful in reconstructing anthropogenic activities. The second group of studies is mainly devoted to changes in physical, chemical, and biological soil properties as well as to interactions between soil functions depending on fire, ash, and char properties. The final group describes the effects of biochar on soil properties and functions such as nutrient availability, C sequestration, microbial diversity and community structure, and heavy metal fixation. The overall conclusion is that fire and the remaining ash and char as well as the application of biochar have short- and long-term consequences for soil. Despite the dramatic effects of fire on vegetation, these factors have many positive effects on soil properties and functions, whereby the influences extend from local, landscape, and regional scales to the global scale.

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